Eur J Vasc Endovasc Surg 11, 257–259 (1996)

## EDITORIAL

# Interposition Vein Cuffs

**Peter Harris,[1] Tony da Silva[1] and Thien How[2]**

[1]*Department of Vascular Surgery, Royal Liverpool University Hospital, Liverpool and*
[2]*Department of Clinical Engineering, University of Liverpool, Liverpool, U.K.*

When limb salvage is the goal, prosthetic grafts must be employed for femorodistal bypass if there is insufficient length of autologous vein of adequate quality available. Those constructed from expanded polytetrafluoroethylene (ePTFE) are most favoured currently but the performance of all prosthetic materials is substantially inferior to that of autologous vein especially when the bypass must extend distal to the popliteal artery. While the search continues for better synthetic arterial substitutes vascular surgeons have attempted to compensate for the mechanical and biological deficiencies of prosthetic grafts by the application of various adjuvant therapeutic strategies. These include supportive drug therapies such as administration of low-dose aspirin, long-term anticoagulation and infusion of a prostacyclin analogue. Of these only aspirin has been shown to have any appreciable beneficial influence upon graft patency rates. Suppression of anastomotic myointimal hyperplasia by manipulation of the genetic composition of vascular endothelial or smooth muscle cells is an interesting idea for the future. But, currently the best chance of improving the performance of ePTFE grafts rests with refinements to the surgical techniques employed for the bypass procedure itself.

The construction of an adjuvant arteriovenous fistula at or close the distal anastomosis is a technique advocated by some.[1] Its purpose is to accelerate blood flow in the graft above a theoretical thrombotic threshold velocity level, but there is no scientifically acceptable evidence that patency rates can be improved as a result. Only a positive outcome from a properly controlled randomised trial is likely to persuade the sceptical majority of vascular surgeons that this device may have a useful role.

By contrast, the interposition of vein patches, cuffs or collars between graft and recipient artery at the distal anastomosis are techniques which have been adopted by increasing numbers of surgeons during the last few years. Originally employed to facilitate technically demanding vascular anastomoses it now seems possible that they may carry other serendipitous benefits. It has been observed that when ePTFE grafts with distal vein patches or cuffs do fail the recipient artery and run off vessels remain patent and remarkably free from myointimal hyperplasia. A similar phenomenon has been noted in experimental studies in dogs[2] and although the mechanism remains poorly understood there is reasonable cause to believe that these techniques may impact to advantage upon anastomotic myointimal hyperplasia which is responsible for at least one third of all ePTFE graft occlusions.

The interposition vein patch technique for anastomosis of saphenous vein grafts was first described by Linton and Wild[3] in 1970 and adapted for use with ePTFE grafts by Bernhard[4] in 1981. The modern version of this operation, popularised by McFarland and Taylor[5] in 1988, involves extension of the patch for a distance of 2–3 cm into the recipient artery to create an elongated funnel-shaped anastomosis. Siegman[6] was responsible for reporting the first vein cuff procedure in 1979 but Miller *et al.*[7] in 1984 were more successful in drawing the technique to the attention of other vascular surgeons. The latest configuration proposed by Tyrrell and Wolfe[8] in 1991 attempts to combine what they perceive to be the best features of the Taylor patch and the Miller cuff.

Although these authors have all claimed advantage from application of their techniques evidence of

1078–5884/96/030257 + 03 $12.00/0 

efficacy, where any has been offered, has been based without exception upon uncontrolled series and in some cases the numbers have been so small as to represent little more than anecdote. However, there are now a number of properly controlled randomised trials underway, the most advanced of which is that undertaken by the Joint Vascular Research Group of Great Britain and Ireland. Formal publication of the results of this trial is being delayed pending completion of a minimum follow-up period by all subjects entered but preliminary results, presented to the Vascular Surgical Society of Great Britain and Ireland in 1994 and published in abstract form,[9] already show a statistically significant advantage for ePTFE grafts with Miller cuff over similar grafts without cuff when the distal anastomosis is to vessels below the level of the knee joint. The results to date show no difference in patency rates associated with the use of the Miller cuff for more proximal grafts and this suggests that the technique is of benefit mainly for small vessel anastomoses. Definitive proof of the value of vein cuff techniques must await the completion of this and other trials in progress but on present evidence a degree of cautious optimism would seem to be justified.

Speculation about the mechanisms by which interposition vein patches, cuffs and collars might modulate anastomotic myointimal hyperplasia is considerably more than idle curiosity. Better understanding of how they work might lead to the design of more efficient anastomotic configurations but could also provide new insight into the basic pathogenesis of myointimal hyperplasia itself. Two theories, not necessarily mutually exclusive, predominate; buffering of compliance mismatch between the comparatively rigid ePTFE and the recipient artery, and alteration of local haemodynamics at the anastomosis.

It has been demonstrated in laboratory experiments that a strip of long saphenous vein is more compliant in its longitudinal than in its transverse axis[10] and it has been suggested that the Miller cuff technique benefits from this property. However, nobody has yet shown any evidence to support the hypothesis that compliance mismatch is an important factor in the pathogenesis of myointimal hyperplasia. When vein cuffs are examined by cine digital subtraction angiography a month or more after operation it is impossible to detect any wall movement with the pressure pulse which suggests that cuffs themselves rapidly become virtually non compliant *in vivo*. The case for buffering of compliance mismatch therefore remains very much *sub judice*.

The case in favour of a haemodynamic mechanism is perhaps a little stronger but also remains unproven. An interesting observation from laboratory bench model studies is that "Miller cuff" anastomoses are associated with the formation of a large coherent vortex within the cuff itself, and the same phenomenon can be demonstrated *in vivo* by cine angiography or colour duplex scanning.[11] It has always been assumed that undisturbed laminar blood flow is the ideal. This is certainly true for normal arteries which have not suffered endothelial trauma and do not naturally include end to side junctions. However, circumstances are very different from normal when a prosthetic graft is anastomosed to an artery. Endothelial trauma, which is inevitable at the time of surgery, is the principle cause of myointimal hyperplasia and there are likely to be other factors present in prosthetic grafts but not in autologous vein grafts which aggravate this process. It is known that flow phenomena that lead to high shear stresses on the arterial wall suppress the formation of myointimal hyperplasia while conversely low shear stresses promote it. This accounts for the usual distribution of myointimal hyperplasia at the heel, toe and on the floor of end to side vascular anastomoses. There are reasons to believe that a large coherent vortex, of the type observed within the Miller cuff, might result in greater shear forces being exerted upon the arterial wall than normal laminar flow and this is a possible, although at this stage very speculative, explanation for the beneficial effect of this surgical technique. Shear stress mapping utilising a laser Doppler system in the laboratory and possibly magnetic resonance imaging in patients should provide the means to confirm or refute this theory.

Clearly more scientific study is needed to elucidate further the mode of effect of interposition vein patches and cuffs and this could result in the evolution of more efficient configurations of anastomosis in the future. Meanwhile, there is probably sufficient evidence now to justify the routine use of an interposition vein cuff whenever a vascular surgeon is obliged to attempt a prosthetic rather than an autologous vein graft to salvage a critically ischaemic limb by femoroinfrageniculate arterial bypass.

## References

1 Harris PL, Bakran A, Enabi L, NottD. ePTFE grafts for femorocrural bypass-improved results with combined adjuvant venous cuff and arteriovenous fistula? *Eur J Vasc Surg* 1993; **7**: 528

2 Suggs WD, Henriques HF, DePalma RG. Vein cuff interposition prevents juxta-anastomotic neointimal hyperplasia. *Ann Surg* 1988; **207**: 717.

3 LINTON RR, WILD WL. Modifications in the technique for femoropopliteal saphenous vein bypass autografts. *Surgery* 1970; **67**: 234.
4 BERNHARD VM. Technical manoeuvers to facilitate bypass to popliteal and tibial vessels. In: Greenhalgh RM, ed. *Femoro-distal bypass*. London: Pitman, 1981; 198–205.
5 MCFARLAND RJ, TAYLOR RS. Une amelioration technique d'anastomose des protheses arterielles femoro-distales. *Phlebologie* 1988; **41**: 229–234.
6 SIEGMAN FA. Use of venous cuff for graft anastomosis. *Surg Gyn Obstet* 1979; **148**: 930.
7 MILLER JH, FOREMAN RK, FERGUSON L, FARIS I. Interposition vein cuff for anastomosis of prosthesis to small artery. *Austr NZ J Surg* 1984; **54**: 283.
8 TYRRELL MR, WOLFE JHN. New prosthetic venous collar anastomotic technique: combining the best of other procedures. *Br J Surg* 1991; **78**: 1016–1017.
9 STONEBRIDGE PA, HOWLETT R, PRESCOTT R, RUCKLEY CV. Randomised trial comparing polytetrafluoroethylene graft patency with and without a Miller cuff. *Br J Surg* 1995; **82**: 555–556.
10 TYRRELL MR, CHESTER JF, VIPOND MN *et al*. Experimental evidence to support the use of interposition vein collars/patches in distal PTFE anastomoses. *Eur J Vasc Surg* 1990; **4**: 95–101.
11 DA SILVA A, HOW TV, HARRIS PL. Imaging of local haemodynamics in interposition vein cuffs by dynamic duplex scanning and cine-DSA. In: Greenhalgh RM, ed. *Vascular imaging for surgeons*. London: WB Saunders, 1995; 389–398.

*Accepted 18 August 1995*